

### **What is claimed is:**

**[Claim 1]**      1. An antenna, comprising:

a central core, having a central coupling region ;

one or two pairs of radiating antenna lines, formed a surface of the central core; and

a balun transformer, formed on a circuit board and electrically coupled to the pair of radiating antenna lines,

wherein the circuit board has a protruding structure to affixing into the central coupling region of the central core, wherein a signal input/output (I/O) end of the antenna is at another end of the balun transformer.

**[Claim 2]**      2. The antenna of claim 1, wherein the central core includes a dielectric rod.

**[Claim 3]**      3. The antenna of claim 1, wherein the two pairs of radiating antenna lines form a quadrifilar helix antenna (QHA).

**[Claim 4]**      4. The antenna of claim 1, wherein the one pair of radiating antenna lines forms a bifilar helix antenna (BHA).

**[Claim 5]**      5. The antenna of claim 1, wherein the pair of radiating antenna lines includes a meander structure or a line-width adjusting structure at a location, at which a current is minimal.

**[Claim 6]**      6. The antenna of claim 1, wherein the pair of radiating antenna lines includes a meander structure or a line-width adjusting structure at a central region of each of the helix antenna lines.

**[Claim 7]**      7. The antenna of claim 1, wherein the balun transformer includes two paths, and each of the paths includes a capacitor and an inductor, so that a desired equivalent length for each of the paths is obtained.

**[Claim 8]**      8. The antenna of claim 7, wherein one of the two paths has an equivalent one-quarter wavelength and another one of the two paths has an equivalent three-quarter wavelength.

[Claim 9] 9. The antenna of claim 7, wherein the two paths of the balun transformer are formed on a same side of the circuit board.

[Claim 10] 10. The antenna of claim 7, wherein the two paths of the balun transformer are formed on different side of the circuit board.

[Claim 11] 11. The antenna of claim 1, wherein the central coupling region of the central core has a hole with a groove, so as to adapt the protruding structure of the circuit board.

[Claim 12] 12. A balun structure, suitable for use in electrical coupling to an antenna radiating part, the balun structure comprising:

a circuit board;

a first path on the circuit board, including a circuit formed from a capacitor and an inductor, so as to have a first equivalent length with respect to an operating wavelength; and

a second path on the circuit board, including a circuit formed from a capacitor and an inductor, so as to have a second equivalent length with respect to the operating wavelength, wherein an equivalent length difference between the first and the second paths is half wavelength,

wherein the first path and the second path have a commonly connected node for serving as a signal input/output (I/O) end.

[Claim 13] 13. The balun structure of claim 12, wherein the first wavelength path and the second wavelength path are on the circuit board on a same side or on different sides of the circuit board.

[Claim 14] 14. The balun structure of claim 12, wherein the balun structure is also used to match impedances between a 50-ohm signal line and an input impedance of the antenna radiating part.

[Claim 15] 15. The balun structure of claim 12, wherein the inductor for each of the two paths is a metal line.

**[Claim 16]**                16. A wireless communication apparatus,  
                                 comprising:

a main functional unit; and

an antenna as recited in claim 1, for transmitting and receiving radio-frequency (RF) signals.

**[Claim 17]**                17. The wireless communication apparatus of claim  
16, wherein the pair of radiating antenna lines includes a meander  
structure or a line-width adjusting structure at a location, at which a  
current is minimal.

**[Claim 18]**                18. The wireless communication apparatus of claim  
16, comprising a mobile phone.

**[Claim 19]**                19. The wireless communication apparatus of claim  
16, wherein the balun transformer includes two paths, and each of  
the paths includes a capacitor and an inductor, so that a desired  
equivalent length for each of the two paths is obtained.

**[Claim 20]**                20. The wireless communication apparatus of claim  
19, wherein the two paths have an equivalent length difference by  
half wavelength.